Solar Powered Water Pump System

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Abstract

Solar energy is the most abundant source of energy in the world. Solar power is not only an answer to today's energy crisis but also an environmental friendly form of energy. Photovoltaic generation is an efficient approach for using the solar energy. Solar panels (an array of photovoltaic cells) are nowadays extensively used for running street lights, for powering water heaters and to meet domestic loads. The cost of solar panels has been constantly decreasing which encourages its usage in various sectors. One of the application of this technology is used in irrigation systems for farming. Solar powered irrigation system can be a suitable alternative for farmers in the present state of energy crisis in India. This a green way for energy production which provides free energy once an initial investment is made. In this project we propose an automatic irrigation system using solar power which drives water pumps to pump water from bore well to a tank and the outlet valve of tank is automatically regulated using controller and moisture sensor to control the flow rate of water from the tank to the irrigation field which optimizes the use of water. The paper is divided into 6 sections discussing the literature survey, proposed solution, implementation, cost analysis and results and conclusion, references. Cost effective solar power can be the answer for all our energy needs. Solar powered smart irrigation systems are the answer to the Indian farmer. This system consists of solar powered water pump along with an automatic water flow control using a moisture sensor. It is the proposed solution for the present energy crisis for the Indian farmers. This system conserves electricity by reducing the usage of grid power and conserves water by reducing water losses.

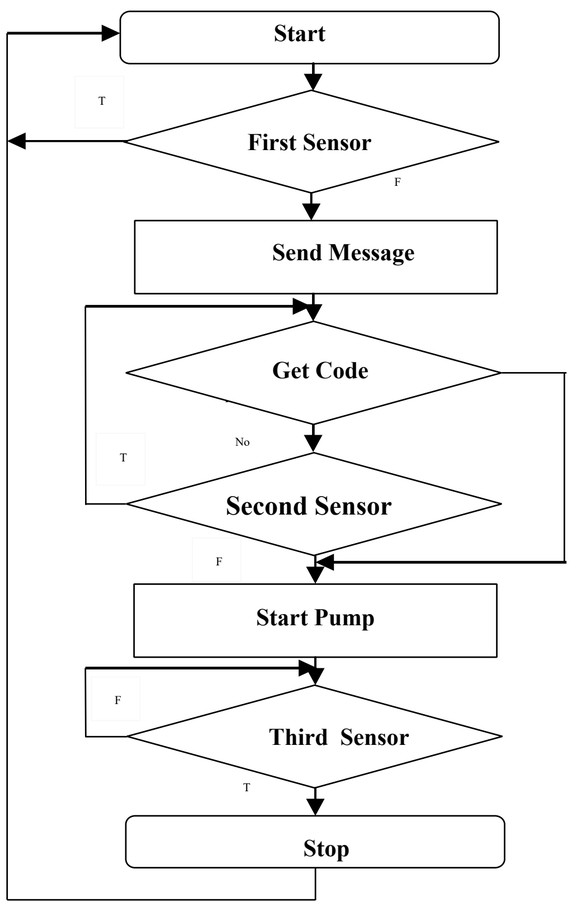
Introduction

The Food and Agriculture Organization of the United Nations, estimates that agriculture accounts for 70% of all water consumption, compared to 20% for industry and 10% for domestic. Critical need therefore exists to implement water conservation practices in agriculture. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements. The average daily water consumption for a pair of farm animals during the summer is approximately 20 gallons per day. With increase in global warming, more remote areas will need to be cultivated, meaning far of areas will need to have access to water. A lot of water has been wasted because of careless management of manual irrigation system. With our system we plan to develop and optimize the usage of water across the world.

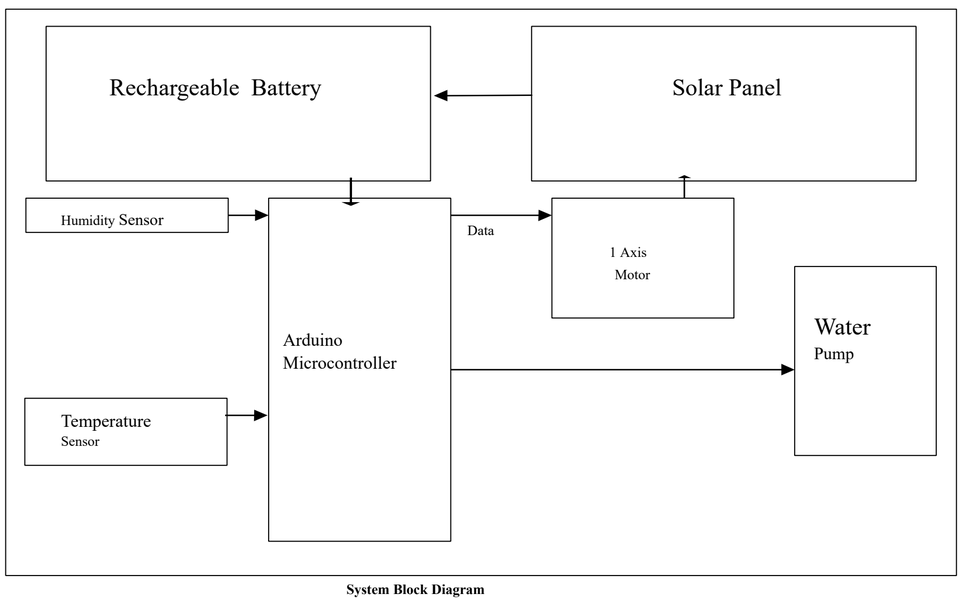
Keywords: Smart irrigation; solar power; solar pump; moisture sensor; energy crisis

Working Principle/Calculation

The working principal of our system I s simple. Based on variables like soil and air humidity, temperature and battery voltage. We continuous decide whether there is a need to pump water or not. The logical approach is to decide the requirement to pump water during the sunlight hours and charge the battery running the system with the maximum potential based on the rotating mechanism of the solar panel. The Water pumps are powered by the photovoltaic or PV array. There are three elements which include the pump itself, its controller and the array and with only these three elements you can have a relatively inexpensive system that is low maintenance. The system is expected to operate if there is sunlight and water to pump. It is a good idea to either or both have water storage means and or having the array 'oversized' to pump water under low light conditions.



Block Diagram



System Block Diagram

We wanted our system to work numinously Design a sustainable low-cost, low-power, drip-irrigation system to control and reduce water waste in farming To design the simple and practical irrigation system that using Solar Panel. The sub-system should be able to operate in real-time, and remotely without human intervention The design should be tailored to work in any landscape Weather conditions are to be taken into consideration. Develop a smart charger controller to collect and store solar energy in battery.

Device Fabrication & Components

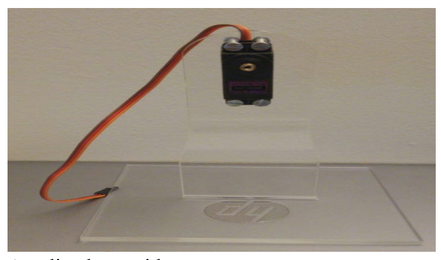
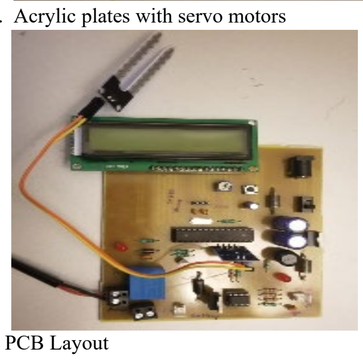


Fig. Acrylic plates with servo motors



PCB Layout

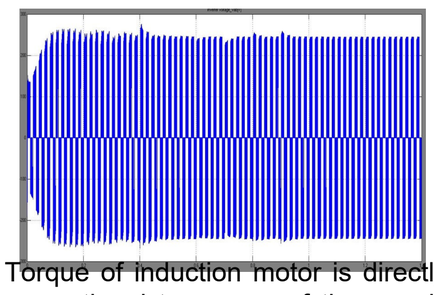
Irrigation water pump

Solar Panel

Simulations

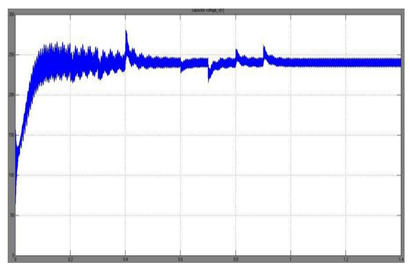
We Used a three phase induction motor model in mat lab to run our simulations. The Boost regulator provides an output voltage which is less than or greater than the input . It has low switching losses and has high efficiency. The solar generated electric energy may be stored in the battery storage.

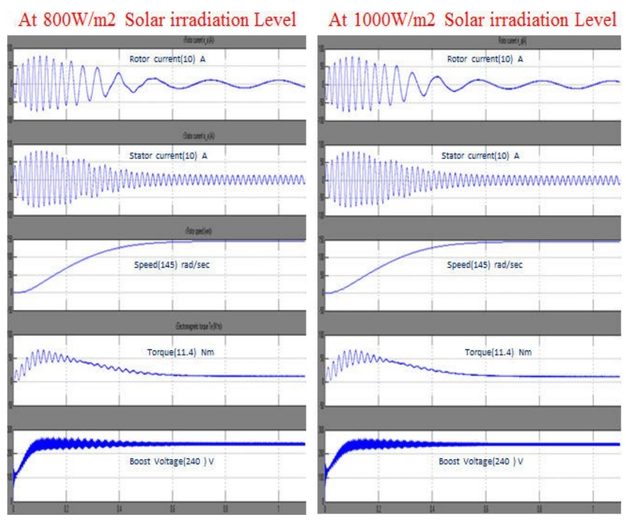
It provides continuous power supply to the load without interruption. Inverter is a solid state circuit which converts the battery bus voltage into AC of required frequency and phase to match that needed to integrate with the utility grid or to a frequency sensitive load like AC motors. The configurations of inverters are 120 degree conduction mode and 180 degree conduction mode. Among these two configurations, the inverter with 180 degree conduction mode is used to get its own technical advantages.



Torque of induction motor is directly proportional to square of the supply voltage. It is observed that at two different solar irradiation levels i.e., 800W/m^2 and 1000W/m^2 boost converter voltage is same in both cases but PV voltage is different. But the induction motor output parameters speed, torque, stator and rotor currents are didn't change.

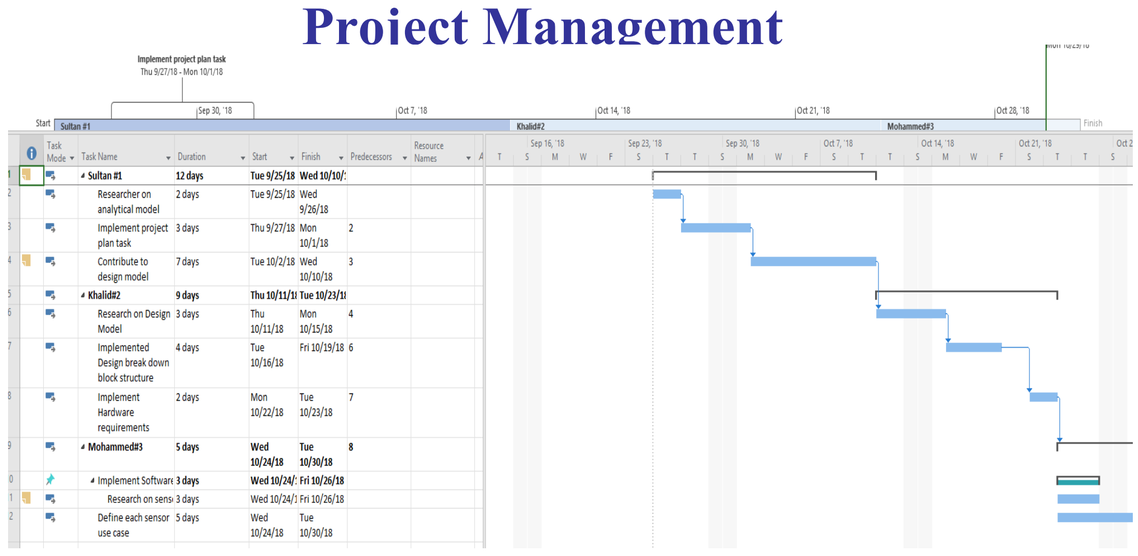
Figure shows a sinusoidal load current for phase a. The DC voltage produced by the photovoltaic system is converted into AC current to the load. It is clear from the figure that speed of the induction motor is constant without any oscillation. Induction motor is controlled by v-f control technique. Speed of the induction motor is dependent on frequency of the supply voltage. Frequency of the supply voltage is maintained constant by using SPWM technique





From the Above graph Inversion of boost converter output dc voltage into ac by using three phase inverter which is controlled by Sinusoidal pulse width modulation technique. The dc voltage is inverted into ac as of same magnitude with reference frequency.

Project Management



Future work and Implementation Plans

In this research we proposed a solar-powered Arduino-controlled "smart" irrigation system for agriculture applications. The proposed system can monitor the humidity and temperature of the land, and automatically decide when to turn on and off the pump for irrigating the plants in a farm. It can lead to improved efficiency in water usage and reduce waste of water. Furthermore, we introduced solar energy to be used for the irrigation system. Solar energy is totally clean and sustainable. It can help save energy and protect the environment. We have performed theoretical analysis and simulations to verify the design of the system. In the next step, we are going to order required parts and actually implement the system. We will test the system and verify the expected functions we intend to achieve. We will further add more features (e.g. connectivity to smart phones and internet) into the system to make it even better.

References

[1]. Devika CM, et al., "Automatic Plant Irrigation System using Arduino", Proceedings of 2017 IEEE International Conference on Circuits and Systems (ICCS2017).